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freezing point method uses weight normal, whereas the plasmolytic method uses volume normal solutions. He shows conclusively in his discussion that it is the plasmolytic method which has been in error.

The large error of the old method is illustrated by the cryoscopic measurement of a volume normal cane sugar solution. The depression of the freezing point is -2.66°C. , which indicates an osmotic pressure of 32 atmospheres instead of 22.4 atmospheres. The excess pressure is due to the sugar being dissolved in less than 1000 cc. of water. A comparison of the pressures for 67 per cent cane sugar and 18.5 per cent NaCl as calculated from the volume normal and weight normal concentrations is very illuminating also. The NaCl solution contains 3.6 moles of salt, 50 per cent ionized, in a liter of solution; while the sugar solution contains only 2.6 moles, with no ionizing, per liter. The NaCl should develop a much higher pressure according to the plasmolytic method of estimating pressures; but adopting the method of MORSE, now shown to be correct, which demands equal quantities of solvent, we find that the NaCl is dissolved in 928 cc., the sugar in only 439 cc. of water. The relations of the two solutions are seen to be actually the reverse of what the plasmolytic method indicates. Owing to the dissociation of the NaCl, the solutions are really nearly isosmotic. These examples serve to show the unreliability of the plasmolytic determinations with volume normal solutions, and the necessity, despite their inconvenience, of using weight normal solutions in the future.

It is unfortunate that the physical chemists have not determined the osmotic pressure of saturated solutions by the cryoscopic method. While RENNER makes clear that at the concentrations thus far measured the freezing point determinations will give the correct osmotic pressure, it remains to be demonstrated that this holds for all concentrations whatsoever. The direct determinations by Lord BERKELEY and HARTLEY for concentrated sugar solutions exceed the measurements called for even by the MORSE-FRAZER method. At present, the reviewer believes that these direct measurements, recently confirmed by TROUTON, are the most trustworthy determinations we have for concentrated solutions. If the cryoscopic methods should yield results in agreement with the direct measurements at these same concentrations, and with saturated solutions of various salts, its universal application could be admitted. If it does not, then still further correction of the formula for calculating the osmotic pressure of solutions must be made. Every physiologist interested in the determination of osmotic pressures should by all means read RENNER's excellent discussion.—CHARLES A. SHULL.

Paleobotanical notes.—ARBER⁴ has described 44 species of plants from a coal-field in Gloucestershire, none of which are new to Great Britain. The

⁴ ARBER, E. A. NEWELL, On the fossil flora of the Forest of Dean coal-field (Gloucestershire), and the relationships of the coal-fields of the west of England and South Wales. *Phil. Trans. Roy. Soc. London B* 202:233-281. *pls. 11-13.* 1912.

contribution deals chiefly with stratigraphy, but a fact of botanical interest is that several species, including *Annularia galioides*, *Sphenophyllum majus*, *Lepidodendrom dichotomum*, and three species of *Sigillaria*, were found in a higher horizon (Upper Coal Measures) than known before in Great Britain.

Miss HOLDEN⁵ has begun a series of contributions dealing with the anatomy of mesozoic conifers, the first one giving the results of a study of some Jurassic material from Yorkshire. The collection proved to contain some typically abietineous woods and some typically araucarian woods, but most of the woods were intermediate between the two. It is concluded that the character of these transitional woods corroborates the view that the Abietineae are the oldest conifers and that the araucarians have been derived from them. A remarkably strong statement is the following: "Comparative examination of living and fossil forms leads to the rejection of all criteria except cellulose bars of Sanio as an infallible test for tribal affinities."

Miss HOLDEN⁶ has investigated a collection of lignite from some Middle Cretaceous beds of New Jersey. Most of the plants belonged to *Cupressinoxylon*, *Araucarioxylon*, and *Brachyoxylon*, and will be described later. In the present paper three types of *Pityoxylon* are described as new species: *Pinus protoscleropitys*, *Pityoxylon foliosum*, and *P. anomalum*. The first mentioned is probably the earliest form with all the characters of a modern hard pine, and the occurrence of such a pine as early as the Middle Cretaceous is thought to argue strongly for the great antiquity of the genus *Pinus*. *Pityoxylon foliosum* is probably the wood of *Prepinus*, all the leaves being borne directly on the main axis, and combining characters that are now separated in hard and soft pines. *P. anomalum* has a woody structure like that of *Prepinus*, but all the leaves are borne on short shoots.

THOMAS⁷ has described a leaf from the Jurassic of Yorkshire which he thinks represents a new genus (*Eretmophyllum*) of Ginkgoales. The leaves differ from those of *Ginkgo* in being oblanceolate or linear, but approach those of *Ginkgodium* in outline; the leaves of the latter, however, are shorter and comparatively broader and are often deeply divided at apex. The most important distinction, however, is found in the venation.

SEWARD⁸ has described some dicotyledonous leaves from the coal measures of Assam, which are probably Tertiary, although there are claims that they

⁵ HOLDEN, RUTH, Contributions to the anatomy of mesozoic conifers. I. Jurassic coniferous woods from Yorkshire. Ann. Botany 27:533-545. pls. 39, 40. 1913.

⁶ ———, Cretaceous Pityoxyla from Cliffwood, New Jersey. Proc. Amer. Acad. 48:609-623. pls. 4. 1913.

⁷ THOMAS, H. HAMSHAW, On some new and rare Jurassic plants from Yorkshire; *Eretmophyllum*, a new genus of Ginkgoalian leaf. Proc. Cambridge Phil. Soc. 17: 256-262. pls. 6, 7. 1913.

⁸ SEWARD, A. C., Dicotyledonous leaves from the coal measures of Assam. Records Geol. Survey India 42:93-101. pls. 17, 18. 1913.

belong to the Cretaceous. Of course in the absence of fruits and seeds the determinations are not altogether satisfactory. In any event, the families thought to be represented, each by one to three species, are Magnoliaceae, Anonaceae, Fagaceae, Myristicaceae, Lythraceae, Moraceae, Rubiaceae, Guttiferae, Burseraceae, Anacardiaceae, Ericaceae, Dipterocarpaceae, and Ternstroemiaceae. If one can draw any conclusion from this showing, it is that the dicotyledonous series was represented practically throughout its present extent.—J. M. C.

Morphology of Calycularia.—CAMPBELL⁹ has studied the rare Javanese liverwort *Calycularia radiculosa*, found in small quantities near Tjibodas. The plant is strictly dioicous, the males being decidedly smaller than the females. It perhaps more nearly resembles *Symphyogyna* than *Pallavicinia* (*Blyttia*), with which a comparison is made. The endophytic fungus common to so many liverworts is conspicuous. Two forms of apical cells are present: one is the cylindric-lenticular type found in *Pellia epiphylla*; the other is the cuneate type common to Marchantiales, *Sphaerocarpus*, and most Anthocerotales.

Branching of *Calycularia* he says, "seems to be a true dichotomy, but whether one of the branches retains the original apical cell or whether two new apical cells are developed was not investigated." In order to have true dichotomy, the original apical cell by equal division must give rise to two new apical cells. But if, on the other hand, the original apical cell is retained by one branch, the apical cell of the other branch must be formed from a segment of the original apical cell, and we have, not *true* dichotomy, but *apparent* dichotomy. Of course in most cases, whether we have true or simulated dichotomy makes little difference in the appearance of the adult plant.

The earliest stages of the antheridium were not studied, but apparently it develops like that of the majority of Jungermanniales. In the ultimate division of the spermatogenous cells a wall is formed. No trace of a "Nebenkörper" or "accessory body" was found. Archegonia are grouped on a rudimentary receptacle. The number of neck cells is various, the highest number found being eight. Occasionally a binucleate neck canal cell was found, showing that the neck is being shortened. In one archegonium neck canal cells were enlarged and closely resembled eggs. This seeming reversion to a more primitive type of archegonium seems to be widespread in bryophytes.

Early stages in embryogeny were not studied. The capsule has a relatively thick wall. The foot is the mushroom-anchor shape so common in liverworts. The spore mother cells are deeply lobed, as is characteristic of practically all Jungermanniales. The "quadripolar" spindle of FARMER was

⁹ CAMPBELL, DOUGLAS HOUGHTON, The morphology and systematic position of *Calycularia radiculosa* Steph. Leland Stanford Junior Univ. Publ., Univ. Series, Dudley Mem. Vol. pp. 43-61. figs. 12. 1913.